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Structural Overview

This is an overview of the use of Diversity Harnessing in ECE101. It includes a definition of Diversity Harnessing, a description of the course structure needed to support Diversity Harnessing, and the modifications made to the original design as a functional model takes form through its use in ECE101: Exploring Digital Information Technology at the University of Illinois.

Diversity Harnessing

Diversity Harnessing is a technique for engaging diverse-curriculum students in the STEM disciplines. It began to develop by necessity while I was teaching ECE101: Exploring Digital Information Technologies. At first, the students were asked to spend a couple weeks to explore some aspect of Digital Information Technology not explicitly explored in the course. Some of the projects were more or less literature surveys. Although these projects have merit, the presenters reactions did not display the same level of excitement as those of the students presenting hands-on laboratory solutions.

In a second phase, projects were limited to those that required a laboratory aspect (both software and hardware solutions accepted). To facilitate the hardware projects, I found ways to shorten basic portions of the class so that students were better prepared for logic solutions with several weeks remaining in the semester. Labs were also restructured to provide some time for the students to work on projects within the regular lab sessions. Presentations are now done during the final lab session. The entire ECE staff (instructor plus two TAs) offered dedicated assistance to most projects to move them forward.

The feeling of accomplishment expressed by the students as they completed these self-chosen, open-ended projects was unprecedented. The diversity of the project goals attracted the interests of other students as well as a few outside observers. Of course, by the time this excitement peaked, the semester was ended. It became my goal to infect the earlier portions of the course with this same excitement. The task was to find tasks and goals of the students at a time in the semester when they yet know little about the

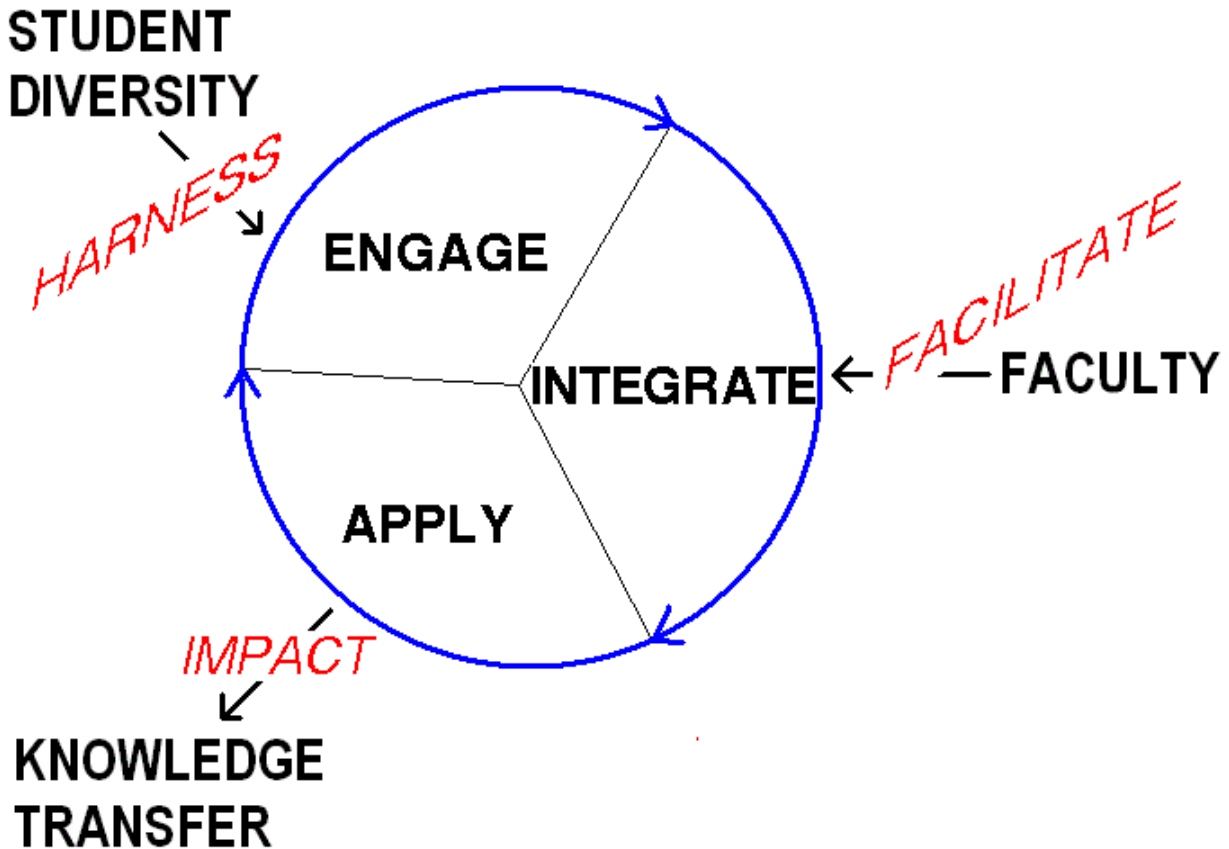
material and much less understand the applications, and then to map those things into materials useful for the course. The obvious problems include how to extract these obscure objectives from the students and map them into useable materials while still performing all the regular day-to-day challenges of teaching: lecture preparation, grading, office hours, writing exams, laboratory preparation, etc. It is all of this that I intend to address under the general methodology of "Diversity Harnessing".

National Science Foundation Grant DUE-0942331

This project is currently funded by NSF DUE-0942331. The full text is available [here](#). A summary of the project and its deadlines can be found [here](#).

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The Diversity Harnessing Cycle



The Diversity Harnessing Cycle

In the Diversity Harnessing "cycle", input from the students is harnessed through the use of questionnaires. The questionnaire seeks to find applications and ideas "outside of the box" for use within the course. As the students witness aspects of their own interests entering into the course material, they find themselves truly engaged in the course.

The content from the questionnaires must be analyzed and fed back into the course material. It cannot be assumed that all inputs from the students will create useable materials for the course. Some inputs may be tangential to the instructor's intention for the question. Other inputs may fall too far beyond the expertise of the instructor. Even the best materials are likely to require massaging to place them into a form that allows the students to recognize the connections between the topics being studied and the application being suggested. In any case, the instructor can expect to devote

significant time into facilitating the integration of the material back into the course.

With the material harnessed from the students fed back into the course as homework problems, test problems and both closed- and open-ended designs, the students will have the opportunity in class to apply their new found skills and have impact outside of the course boundaries. Having already succeeded in having impact beyond the course, it is believed that many students will find success in applying their skills beyond the classroom beyond the semester's end.

For myself, the term ``harnessing" brings forth an image of a horse hitched up to a cart. In this analogy, I wonder who is driving the cart and who the horse may represent. The traditional thought of the instructor driving the course seems to leave us thinking that it is the students who have been harnessed, but this view is truly misguided.

Within the structure of diversity harnessing, it is the students who ride in the cart, all of them holding tight to the reigns and assisting in guiding the harness. Does that leave the instructor as the solitary horse? Without proper course structure (eg. Cooperative Learning techniques), this may very well be how the instructor will feel as he tries to achieve the goals of diversity harnessing. With cooperative learning techniques, the instructor becomes the reigns and harness; the instructor connects the students to the horse in a manner in which they can control the progress. The burden of the work should be carried by the course structure, itself!

Pedagogy Founded on the Three C's

The "Three C's" are an informal subset of the Principles for Good Practice in Undergraduate Education [Chickering and Gamson, 1987 AAHE Bulletin] believed to be essential in providing the foundation for the implementation of Diversity Harnessing. The term was created by Schmitz in the National Science Foundation Grant DUE-0942331 after recognizing the similarity between the terms used to summarize the required course structure and the "Three R's" of education and believing that connection would make these underlying principles memorable.

The Three C's

- Community
- Collaboration
- Accountability

These three form a basis on which students should be provided the confidence and motivation necessary to freely contribute personal observations and experiences (diversity) to the rest of the class (possibly anonymously) where it can be harnessed to enhance learning. Three improvements in the course are anticipated specifically from the harnessing of diversity: better student engagement in learning, integration of students' experiences directly into the course material as applications, and the ability of students to apply the course knowledge to their lives beyond the semester's end.

Pre-Lecture

The original goal was to create and present a 10-to-20-minute module about each topic. The mathematics or other challenging material should be kept to a minimum (or left out entirely). The module would be followed by simply-phrased questions to discover what application students might see for the presented material.

After spending several weeks studying the generation of Flash content, the use of Respondus and Studymate, and other mechanisms that could be used to create content, it was decided that simple tablet or whiteboard recordings would be most accessible, lowest cost, and fastest to produce for any educator. By using a common platform across institutions, material could be more easily shared while maintaining a consistency in format.

Through much trial and error when producing these recorded materials, two things become rather evident: 10 or 20 minutes is a bit long for students to concentrate on a single, unbroken learning module and the content of the module was not typically necessary for the prompting of a Diversity Harnessing question. In response to these observations, the learning modules were reduced to less than 5 minutes in duration. The 5 minute duration often includes an edited 15-minute lecture-like capture that removes much of the dead time that occurs during writing, sketching or

manipulation of the computer software. Although this dead time is, arguably, essential to the process of learning in the traditional lecture setting, it can also be argued that this time is better allocated to post-module group exercises that explore the module more completely.

Examples

I used Camtasia Studio to record reproductions of small, informative portions of my lectures, often recorded later the same day as the lecture was presented in class. The reproductions as well as the lectures were accomplished using an ASUS 121 EP tablet computer. The recordings are, admittedly, quite amateurish but were appreciated by the students and considered a great aid to learning. They are available at [screencast](#) in the ECE101 folder.

Coursera

The University of Illinois and Coursera made an agreement in July of 2012 to provide content for Massive Open Online Courses (MOOCs) and some of the content of ECE101 is scheduled to in the first offering (Fall 2012). This will provide an opportunity to learn more about professional production of lecture materials as well as another avenue of disseminating the materials used for the course. It is to appear [here](#) when it is ready.

Lecture

Rather than require that the module be watched prior to lecture, the shortened nature of the module allows the instructor to have the option of viewing at the beginning of lecture. This method ensures that all students begin the lecture on the same footing and allows for the instructor to address uncertain points prior to group exercises.

At this point, the applications presented by the student body in the previous week's Diversity Harnessing Question(s) can be commented upon ("Several people mentioned [this and that]...") and then one specific application can be selected. Present the mathematical formulation of the problem (that is, map it into an exercise format) and have the students work through a mid-level exercise in groups of two to four students each. Walk around and

assist groups in solving the exercise as needed. After some amount of time, have a group present their solution to the class.

Additional time may then be taken to either present more detail on the topic, work out other exercises based on the applications provided by the students, or another group exercise. You are encouraged to have a demo (hardware, software, interactive, etc.) prepared to keep the lecture period engaging.

Lecture should conclude with 5 minutes remaining for summary and transition to the next topic (although, I have found that this often biases student responses to the upcoming DHQ). Use a "minute paper" to assess student understanding and collect these as the students exit the lecture room. This can also serve as an opportunity to take attendance, for students to rate their team members on that day's performance, or even to ask the Diversity Harnessing Question for applications to be used in the upcoming week.

Office Hours

I have adopted an Elluminate-based (Blackboard Collaborate) office hour period (twice per week) to augment my regular face-to-face office hours. I found attendance of the online office hours to be superior to those of my face-to-face meetings provided prior to 5pm and comparable or even better than the attendance received by the Teaching Assistant at the 6-8pm session.

Assignments

The assignments are to consist of three layers.

The lowest layer is comprised of "catch up" materials, typically geared towards prerequisite knowledge or the most basic application of the problem-solving techniques expected of the students.

The middle layer is comprised of assignments that define the course's required performance (core materials). These are mostly the homework

problems of the past. Mastery of this material should map to a good grade in the course.

The highest layer challenges the student to go beyond the standard course material and encourages students to apply, analyze, evaluate and create (higher levels of Bloom's taxonomy). Student-generated questions (from Diversity Harnessing questions) should appear in this layer. These problems should require less time to complete than Layer 1 problems or be given more credit for problems well-done.

Layer 1 and layer 2 problems are due on Friday just before midnight (online submission). Layer 3 problems are due on Tuesday at lecture (many are anticipated to be handwritten and this provides them a convenient time to turn them in).

Online Assignment Examples

A listing of many of the online Lon Capa homework problems may be found at [this link](#). Level 1 problems are labeled "A", level 2 are labeled "B" and level 3 are labeled "C". Some problems shift level as a result of some restructuring of the course over time. The problems labeled "D" are like level 1 problems, but taken directly from the course notes.

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Diversity Harnessing Questions, Answers, and Usage (Sample Set)

This is a sample set of the types of questions asked in ECE101 to build upon the Diversity Harnessing concept. This module will outline both successes and failures of the questions to draw useful material from the participating students.

Preface

My course, ECE101: Exploring Digital Information Technologies, explores many topics. The common thread in all these topics are that they lead to knowledge in how to produce well-engineered software/hardware solutions to life's many problems. In this module, I highlight just a few of the course topics, the Diversity Harnessing question used associated with that topic, a short list of some responses obtained from the students, and a discussion on how those responses were (or were not) used in preparing course materials.

HTML

"Name up to three web sites that you find particularly fun. Explain what it is that makes each site fun for you." "Which features do you feel you would be able to implement from your experiences in ECE101? Which features to you suspect would be far too difficult?"

Note:My goal was to use the answers to this question to determine applications for HTML/JavaScript that I could code during lecture using only the handful of simple techniques they had already learned (plus maybe one or two more as needed).

Student Response "A"

Three websites that I find particularly fun are youtube.com, halolz.com, and tumblr.com. I like the fact that each of these sites provides original content by their users all in one place and in various forms as well. The layout for each is very easy to use and you can easily share what you find on other

social networking sites with the click of a button.

Besides adding a title, headings, and paragraphs, we honestly can't do too much right now since we don't have much experience. From my past experience working with HTML, I would be able to add pictures, video, hyperlinks, and tables, but aside from those, advanced features like creating a playlist, favoriting, and subscribing may be too difficult at this time.

Note:Response A is quite useful. It provides exact sites that many other students would also be familiar with and interested in. The student also expresses the range of prior experience in HTML and specific skills that are wanting. Unfortunately, the skills they request are **a bit complex for an in-lecture demonstration although we do something similar during lab.** In the end, I used the answers to this question in a different manner: I showed them how to write JavaScript code to allow the class to enter the URLs of their favorite sites using a browser and have the browser automatically generate a website of ECE101's favorite web sites. I may also use the list of websites and descriptive keywords to teach XML to classes in the future.

Note:If the responses don't guide you where you expect, be prepared to make lemonade from lemons by using them in a different manner! Either way, it personalizes the course.

Information

"Give an example of what enters your mind when you hear the word "Information." Devise a short definition of "Information." "

Note:Here, my intent was to categorize the student's various definitions of "Information" to show them that their ideas are, indeed, correct. In this

way, it does not take on too technical a definition when we apply to signal acquisition and file compression.

Multiple Student Responses

- I think of data when I think of information.
- Information = knowledge describing a particular topic
- I think of information as the very basic form of knowledge. Anything that can be spread from one person to another.
- When I think of information...I think of a library or a computer search with access to all that knowledge in that library Definition of information...any known facts or statements, etc. true/false made by a person(s).
- Information – knowledge on demand
- I think of a newspaper when I think of information. My definition is a series of ideas that can empower someone or something to get an answer for a question.
- Characters (letters, numbers, symbols) arranged in a way so as to render them significant, intelligible, and transmittable between more than one entity.
- Information is knowledge.
- To me, information is knowledge that can be shared.
- Information is a intertable (interpretable?) knowledge by any means. When I think of Information, I think of books/Internet and so forth.
- The knowledge of something needed in particular or info or data on a particular subject. I always think of the internet and somebody typing in a question.
- Information is facts, truths, and knowledge. Information can also take the form of pictures, video, and audio.
- Information: Collective amount of data about anything or a specific thing.
- Information: Knowledge about a particular subject.
- Written or scribed symbols that provides a fact, sound, image, or text that is understood as data to people.

- Information Content Messages in a specific order/sequence anything that can be interpreted into a 'message'
- Information: Knowledge. Help you to understand an object.
- Information – It depends in what context. Information journalism can mean contact information, relevance, age, background history, etc.
When it comes to computers and the internet, I think of information as data and all the codes, numbers, and programs that are being utilized. Essentially, I think information and data are interchangeable. (But I'm most likely wrong)
- I believe that information is a collection of facts and knowledge about various subjects that is shared among people and invokes learning or thought.
- When I think of information, I think of data that is transmitted either by technology (internet, media, television, radio) or from person to person.
- Information: technology
- Information – describes and defines something (anything)
- Information Knowledge or something-needed-to-do-a-job. Something passed along to aid in know-how. Data Truths
- Information: truths data
- Information: Characters, symbols or everything contains a particular meaning that people (or animals) want to convey.
- Definition of information: something useful derived from raw data and can be an important role in decision making. Eg. The weather forecast in the next 7 days.

Note: The last item (which mentions "data", "decision making" and "weather forecast") appears tainted by the course notes which are available in advance of the lecture. I accept the fact that this will sometimes occur. I suspect that students who are engaged enough to read lecture notes ahead of the lectures contribute to the class discussions in other ways besides the Diversity Harnessing method. That is to say, they are probably not the students who need the extra effort for engagement in the materials!

Summary of answers: In the next class, I was able to report that most students associate information with knowledge and the transferal of that knowledge. The knowledge itself pertains to any concrete or abstract thing, but the most common examples are concrete such as demographic information or electronic files. Interesting statements include that even "false" information is still information and that information can be conveyed to/from animals as well as humans. It can also be used to "do a job."

This naturally leads to discussions about what information is necessary to make an informed decision. What information is unnecessary? I typically ask the students about a jury who must make an informed decision regarding the guilt or innocence of the accused. I also discuss whether material irrelevant to this decision might be introduced during the trial and what purpose it might serve. Now, the students' answers provide additional fuel for discussion. Now new questions can be derived from the students responses above...

Example:

If I type "What is the weather in Urbana Illinois" into a search engine, does the search criteria treat every word with equal importance? Why or why not?

Answer 1

Of course, you want the students to discuss and propose answers, but you should expect the discussion to focus on more important words like "weather", "Urbana", and "Illinois". Words like "the" probably appear in most searches and carry little importance. The word "what" might be a bit more disputed with regards to its importance, but I would argue that it might guide us to a page where the material is prepared as an answer to a question and may be better directed to what we desire.

Example:

Many of us get information from newspaper articles or RSS feeds. Consider power from wind turbines which has gotten a lot of attention

locally. What is your opinion of the construction of wind turbines in the area? What information have you read? What information did you find most relevant in making your decision? Least relevant?

Answer 2

It is difficult to anticipate answers here or even to know how familiar students may be with this particular issue. It might have been better to have included in the DH question a request for specific information they obtained recently and gear this question around that.

Other Points

A couple of students hinted at the representation or “quantization” of information in some type of symbols: “Characters (letters, numbers, symbols) arranged in a way so as to render them significant, intelligible, and transmittable between more than one entity.”

Note: You should always look for ways to modify a question to obtain more material for use in class. I think a good addition to this question might be "Name a specific 'piece' of information you obtained today and discuss how you used it."

Communication

"Cell phones and the Internet have not always been around, nor are they always the preferred choice of communication today. Name a situation (past or present) where two or more people must communicate where simple voice or Internet communication is not possible. How have they solved this difficulty in communication?"

Note: Here, I wished to find examples where a simplified "alphabet" is developed so that information can be conveyed with low probability of

interpretative error. It serves as a lead-in to Modulation and Forward Error Control.

Multiple Student Responses

- A situation that I've experienced where it was preferred and pretty much necessary was at the place where I work, which is a record label. We are very near the release of a new album of one our bands and we received the first shipment of vinyl that we're distributing. Because vinyl is such a special experience for music lovers and a very textured media form, we all like listening to new vinyl together as a company in the same room to listen to any flaws in the vinyl. It's hard to judge the sound quality via video conferencing and sounds completely different than the digital version.
- In the past, distance was the major obstacle that prevented people from keeping in touch. If anything, you has to utilize transportation to decrease this distance and so you could talk face to face. Thanks to Alexander Graham Bell and the use of wires, people were able to fix this.
- In the absence of electronic communication, people must communicate through other means. Physical mail, messengers, or seeing the individual in person are easy ways (though perhaps not so easy as using technology) to communicate. A friend of mine doesn't own a cell phone, so I had to go knock on his door if I wanted to talk to him.
- In WWI there was only morse code between military officers and personell.
- People have held meetings. This is still a common practice in businesses, communities, and schools.
- In the past there was no internet nor a simple way to communicate with people far away or in another town. In order to communicate they would send letters through mail.
- One of the most notable examples of communication without voice or Internet availability is Morse code. In order to transmit messages without the use of voice communication, messages are encoded into a series of lights, clicks, or tones. Morse code is usually transmitted via

radio and requires the use of a "key" to form the message and a translator to decode it on the receiving line. The concept of coding and decoding messages is the crux of the solution to developing alternate forms of communication.

- When my dad was in college, there is no telephone in his hometown, if he wanted to communicate with his family, he would write a letter to them. It always took two weeks or more to reach. Or if there was a emergency, he could telegraph. Compared to letters, it was much quicker but it still needed around 2 days.
- Not sure about the context, but my first answer would be by writing and traditional mail, sounding some kind of signal whether it be by sound or light display (such as smoke from a fire or a bell being struck), telegraph, or other third-party communication. Cell phones and the Internet have solved such problems by making individual communication completely portable and geographically pervasive. There are cell towers all over the globe now, and even remote reaches can have areas where one can receive a cell phone signal making communication the rule rather than the exception.

Summary of Answers

Many answers contained US mail or face-to-face communication (unintended answers). Others contained smoke signals and Morse code (predictable, less interesting). Notice, however, that the first item above brings a personal aspect to the table in the form of a "recording studio." The student's mention of a recording studio could be expanded so that we could discuss how the recording contractor communicates with the artist during the recording session without interrupting the recording.

Note: The question might be reworded so that it might extract more abstract ideas like American Sign Language or scuba-diver signs. One way to do so may be to include ASL and scuba diver situations directly in the question to push them away from the all-too-obvious answers. I suspect that sometimes it may be better to saturate the question with potential applications to provide enough examples to lead the students away from what might be dominant and trivial answers.

Digital Information

There are many ways to digitize information. For example, I can digitize the approximate flavor of the honey I harvest from my honeybees. Honey is made from many different flowers. In Illinois, major sources include:

1. Alfalfa - *Medicago sativa*
2. Dandelion - *Taraxacum officinale*
3. Soybean - *Glycine max*
4. Sweetclovers, *Melilotus* species
5. White sweetclover-*Melilotits alba*
6. Yellow sweetclover - *Melilotus officinalis*
7. True clovers, *Trifolium* species
8. Alsike clover - *Trifolium hybridum*
9. Ladino - *Trifolium repens*
10. Red clover - *Trifolium pratense*
11. White Dutch - *Trifolium repens*

I can digitize the flavor of my honey by asking the questions:

1. Was alfalfa in bloom during the honey flow? Yes/No
2. Was dandelion in bloom during the honey flow? Yes/No
3. etc...

The answers to my question would produce a 11-bit binary file to roughly describe the flavor my honey. Demonstrate how you can “digitize” something in your life.

Student Response "A"

I can digitize my life by assigning binary numbers to the muscle group I am working out that day, and to get even more specific, i could assign numbers to particular workouts that i am doing within a given workout.

- Back 001

- Chest 010
- Arms 100
- Legs 011
- Shoulders 110
- Cardiovascular Exercises 111
- Lat-pull downs 0001
- Rows 0010
- Pull-ups 0100
- flat bench 1000
- incline bench 0011
- push-ups 0111
- etc...

Note: Other answers were less specific on how digitization would actually be applied. These also make good examples in lecture where you can have the students make suggestions on how to apply 0s and 1s to the information to make it "searchable". See the next response for an example.

Student Response "B"

I could digitize all the movies and books that I've ever read and owned by recording them into a data spreadsheet and organizing them by year/genre/author/title.

Structural Challenges

The capacity to integrate "Diversity Harnessing" into a STEM course rests upon the ability to allocate time to the procedure. Course infrastructure is necessary to allow portions of the course to run smoothly with minimal instructor guidance. This infrastructure is based on what we call the "three C's".

The "Three C's" are an informal subset of the Principles for Good Practice in Undergraduate Education [Chickering and Gamson, 1987 AAHE Bulletin] believed to be essential in providing the foundation for the implementation of Diversity Harnessing. The term was created by Schmitz in the National Science Foundation Grant DUE-0942331 after recognizing the similarity between the terms used to summarize the required course structure and the "Three R's" of education and believing that connection would make these underlying principles memorable.

The Three C's

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These three form a basis on which students should be provided the confidence and motivation necessary to freely contribute personal observations and experiences (diversity) to the rest of the class (possibly anonymously) where it can be harnessed to enhance learning. Three improvements in the course are anticipated specifically from the harnessing of diversity: better student engagement in learning, integration of students' experiences directly into the course material as applications, and the ability of students to apply the course knowledge to their lives beyond the semester's end.

Community

For a small enrollment course, community is not difficult to obtain. Yet, many lecturers fail to take advantage of doing so by applying the proper techniques. An instructor must take time from "traditional" lecturing to solicit discussions from the students. This does not mean to ask a question,

pause, and then retrieve the answer from the one or two students always willing to provide an answer. Better techniques include Think, Pair, Share, problem-based learning (PBL), or even simple team exercises.

To further facilitate community among the students, online communication should also be accomplished. I like to provide a FORUM for the students, but I have found that the FORUM goes unused unless the students are required to use it for a defined goal for several consecutive weeks and rewarded for usage beyond that. I also like using regularly-scheduled Elluminate (now Blackboard Collaborate) for holding on-line office hours. During the first couple of weeks, I would briefly post an image of the student joining the session so that the others would also get to know them. This allows for students to find others in the class with similar challenges and others who may be able to offer help that goes beyond the people who may coincidentally sit near each other in lecture. Our laboratory provides a third avenue for students to build close relationships in the course. Each laboratory session hosts roughly one-fourth of the entire class and partnering within the lab sessions allows students to make personal bonds. Finally, I like to make use of WIKI pages for small group projects to be recorded in a journal-style. Other teams can visit these project pages to learn more about the interests of other students.

Collaboration

While community is about providing the opportunities for students to learn about each other, interact, and form lasting team relationships, collaboration is about teaching each team member how to be individually productive.

In the classroom, there are many collaboration tools, a few of which were mentioned above (eg. TPS and PBL) which may be used to provide the students the opportunity to work cooperatively. Along with these techniques, the students should be provided with the roles in which each might serve to keep the team on task. It often serves well to have one student serve the more technical role (driver) and the other a more managerial role (navigator...or perhaps devil's advocate). Some tasks of fairly low technical difficulty should be interspersed to provide multiple team members an opportunity to change roles.

Outside the classroom, there are other tools to allow for productive collaboration. Using a course WIKI to complete a project would allow for different members of the team to provide varying methods of participation within a project. A less technical team member could be in charge of initiating the web page, populating it with "standard materials" like the title, goal, and methods to be used in the project and even initiating a journal for tracking the progress of the project. Another team member may be responsible for writing up the technical aspects of the project while a third member verifies that the explanation is complete yet simple.

Accountability (old school 'Countability?)

Community and Collaboration provide the opportunity and structure for working as a team. Accountability ensures that they do so each time they are asked to do so. Of course accountability is provided when students are expected to perform well on course assessments like exams, homework and laboratory assignments, but they should also be expected to be accountable for their day-to-day performance in lecture, especially as it pertains to community and collaboration and all aspects of Diversity Harnessing.

Example:

If a classroom has 10 or more teams and you are uniformly likely to call upon one of them in each lecture meeting, the team may recognize a low-likelihood of being called upon and choose not to diligently solve problems. In a 16-week semester course, there are roughly 30 lectures and they would only suffer the embarrassment of being called upon without an answer 3 times!

One answer is not to have a team present an entire solution, but rather have multiple teams offer portion of the solution consecutively. Another idea would be to call upon different teams to present a summary of their solutions...being careful to have them prepare the summary first and present it to you rather than allowing them to say, "Yeah, that's what I had too."

Another possibility is to not present any solution, but have the teams all hand them in and allow you to choose a solution from among them while providing a grade to each team based on EFFORT!

Automatic Accountability: Two steps forward, one step back?

One of my greatest successes was also a partial failure...at first. In 2010, we mapped a great number of assignments to the Lon Capa learning management system so that accountability for completion of the assignments could be automated by the software's auto-grading capability. This worked well and contributed to generating free time for the TAs. Unfortunately, I was not prepared for two things. First of all, the TAs were generally not prepared or motivated for generating materials from the Diversity-Harnessing Questions. Instead, I took the opportunity to have them build a small set of laboratories that I considered to be missing from the curriculum. Unfortunately, defining the goals and many details of these labs also took away from my own time needed for facilitating formation of DHQ into course materials. Secondly, the online assignments were generally viewed as an independent venture and not a team exercise...and true, I wanted each student to finish their own set of problems to gain the expertise needed for the exams. But, unfortunately, a large sense of collaboration was lost as students are far more comfortable working in teams on hand-written assignments. This later problem was solved, in part, by ensuring that each week's assignment contained both an on-line component and a more-challenging written component, the latter of which could be completed as a team. Often that written component was based on the DHQ.

Having the written portion of the weekly assignment based on the DHQ provided accountability for myself! It requires quick turn around on each week's Diversity Harnessing questionnaire in order to be prepared to write and post an assignment based on that material.

Diverse Solutions

In ECE101 while using the method of diversity harnessing, we have witnessed an increase in student projects that are both self-inspired as well as potentially marketable. We outline a few of them here.

In ECE101 while using the method of diversity harnessing, we have witnessed an increase in student projects that are both self-inspired as well as potentially marketable. We outline a few of them here.

Low-Cost Lecture Capture System

Motivated by his own visual impairment, this student prototyped a three-servo motor, one-USB video camera system utilizing the Parallax BASIC Stamp II microcontroller. The student did not have prior experience in building hardware and his disability was an additional impairment to doing so on his own. Empowered by his early success, he continued his project beyond the end of ECE101 as an "Independent Study", produced a fully-enclosed lecture capture system, and presented it at the University of Illinois's Engineering Open House held in March, 2012.

Artistic, Wearable Soft Circuits

Motivated by her own personal interests, this student constructed a soft-circuit, LED-illuminated quilt that responds to sound and appears to "dance" to music. This student did have prior experience in building such hardware, but found ECE101 to provide additional motivation for completion of her plans. She also felt compelled to present at Engineering Open House in March, 2012, but pressed herself to complete an entirely different project in the few months leading up to that event. Her music-activated skeletal costume based on the Arduino "LilyPad" received much attention including commercial interest.

Smart Phone TV Remote

Motivated by the potential of smart phones, this student proposed modifying his phone with an external USB device to transform it into a TV remote. After working through basic engineering design steps, he modified his design to use the stereo jack instead of USB thereby saving on both hardware and software development time. The student was able to demonstrate a device capable of turning a television on and off from a very

short distance by the end of ECE101. He has plans to complete an Independent Study to design and build a more robust and versatile device.